PERFORMANCE STUDY OF PARALLEL IMPLEMENTATION OF TEXTURE IMAGES USING GLCM

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This thesis dedicated to my beloved family, and all who have helped me along the way.

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ABSTRACT

The process of the creation of texture images derived from a windowed GLCM coupled with the calculation of Haralick features for each window is a time intensive process due to the intense number of calculations involved. This study examines and seeks to quantify the expected increase in processing speed when migrating this algorithm from a traditional serial implementation to a parallel implementation of the same function using modern Graphical Processing Units and the effects of certain parameters such as window size and image size. The components of texture images and some of the factors relating to the efficiency of CUDA code are described. The problem domain was analysed and a serial version of texture window analysis was implemented and checked for accuracy by comparing it to code written in Matlab. The serial code was tested on a 2.4 Ghz Intel core i5 processor while the parallel code was tested on two different GPU cards, a GeForce 310M and a GeForce GTX 620. The final (fastest) implementation used three kernels. Two of these performed gray scale conversion and intensity scaling while the third performed the entire GLCM construction and feature extraction. The results showed that a single large kernel could outperform the collection of small kernels that was used in the alternative implementation. As a result of parallel implementation, texture analysis of a 2048 x 2048 pixels image was found to be up to 44 times faster than the serial version using the GeForce 310M and even faster on the GeForce GTX 620.

ABSTRAK

Proses membentuk imej-imej tektur dari tetingkap GLCM berserta pengiraan ciri-ciri Haralick adalah satu proses yang lama kerana ia melibatkan banyak pengiraan. Dalam penyelidikan ini, pengukuran kepantasan dalam pemprosesan tersebut dikaji apabila algoritma tradisional sesiri dilaksanakan secara selari menggunakan Unit Pemprosesan Grafik yang moden. Peningkatan kepantasan apabila parameter seperti penambahan saiz tetingkap dan saiz imej juga diselidik. Kajian ini juga menjelaskan tentang komponen imej-imej tektur dan faktor yang berkaitan dengan penggunaan kod CUDA secara optimum. Masalah dalam kajian ini dianalisis termasuk perlaksanaan analisis tersebut terhadap tingkap-tingkap tektur versi sesiri. Ketepatan hasil kerja diperiksa dengan membandingkannya dengan kod yang ditulis menggunakan Matlab. Kod sesiri diuji menggunakan pemproses Intel Core i5, 2.4 GHz. Kod selari diuji menggunakan GPU yang berbeza, GeForce 310M dan Geforce GTX 620. Kajian menggunakan tiga kernel untuk melaksanakan pemprosesan membentuk imej-imej tektur dan pengiraan ciri-ciri Haralick didapati paling pantas. Dua kernel yang pertama memproses penukaran imej berwarna kepada imej hitam-putih/kelabu dan melaksanakan pengskalaan imej kelabu tersebut. Kernel ketiga memproses penghasilan GLCM bagi setiap imej pixel dan melakukan pengiraan untuk mendapatkan ciri-ciri Haralik. Keputusan menunjukkan bahawa penyelesaian menggunakan satu kernel yang menyelesaikan masalah yang banyak adalah lebih baik daripada penyelesaian menggunakan banyak kernel yang menyelesaikan masalah yang kecil. Perlaksanaan selari menggunakan GeForce 310M bagi 2048x2048 imej pixel adalah 44 kali lebih pantas berbanding perlaksanaan secara sesiri dan keputusan ujian menggunakan GeForce GTX 620 adalah jauh lebih pantas.